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Assessing the psychosocial dimensions of frailty among older adults in Singapore: a community-based study

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Title

Assessing the psychosocial dimensions of frailty among older adults in Singapore: a

community-based study

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A competing interests statement

The authors declare that they have no competing interests

Authors' contribution

HY, EC, AL, LY, and FM conceived the design for the current study. EC, AL, LY, and FM

conducted and managed the survey data collection. HY, STN and SA conducted the data

analysis. EC and AL wrote the first draft of the manuscript under the supervision HY, who

later revised and made the final draft. The final draft was meaningfully commented on by all

authors. All authors approved the version of the manuscript to be published.

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A data sharing statement

The datasets used and/or analysed during the study are available from the corresponding author on reasonable request.

Word count

3,918 / 4,000 words

Abstract

Objectives: To examine how multiple dimensions of mental and social health, in addition to physical health, were associated with frailty among older adults

Design: A door-to-door sampling household community-based survey

Setting: Thirty-two public housing blocks within a residential town in Singapore's central region

Participants: 497 residents aged 60 years or older from the public housing town.

Outcome measures: Physical frailty was assessed using the FRAIL scale. Physical health was assessed by multimorbidity, physical activity, and functional ability; mental illness by the General Health Questionnaire; and social domains by the Lubben Social Network Scale, Community Integration Measure and UCLA loneliness scale.

Results: Compared to robust (59.5%) and pre-frail (32.6%) older adults, frail adults (7.9%) reported higher morbidity, lower functional ability and physical activity, higher scores on GHQ, and lower scores on all three social health scales. In multiple regression models, frailty was significantly associated with an age of 81-90 years (adj. OR = 2.22, 95% CI: 1.23-3.99), having 2-3 (adj. OR=1.56, 95% CI: 1.02-2.38)) or > 3 (adj. OR=1.83, 95% CI: 1.05-3.18) chronic diseases, reduced ability to perform daily tasks without assistance (adj. OR=0.41, 95% CI: 0.23-0.73), having fallen in the past 6 months (adj. OR = 2.18, 95% CI: 1.18-4.06), social dysfunction in GHQ (adj. OR=1.24, 95% CI: 1.08-1.43), and loneliness (adj. OR=1.26, 95% CI: 1.06-1.50). Physical activity did not remain significantly associated with frailty when mental and social health-related factors were entered in the regression.

Conclusion: The study findings the importance of community intervention in mental and social health among older adults for prevention and management of frailty in later life.

Keywords: Frailty, social frailty, mental health, social networks, loneliness, Singapore

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Strengths and limitations of this study

- The community-based household survey enabled to produce an epidemiological profile of physical and social frailty among older adults in a public housing town in Singapore.

- The study used multidimensional assessments of physical, social and mental health to examine the psychosocial dimensions of physical frailty.

- The nature of cross-sectional survey limited inference on the directionality of associations.

- Cognitive function, a confounder of frailty, was not adjusted in the analysis as a formal assessment of cognition was not conducted in the study.

Introduction

Frailty is a common geriatric state which affects roughly 10% of people aged 65 years and above.[1] While there are several definitions of frailty, it is commonly known as a clinical syndrome involving multiple signs and symptoms;[2] one can be considered as frail with three out of these five phenotypic criteria: low grip strength, low energy, slowed walking speed, low physical activity, and/or unintentional weight loss.[3] Frailty increases the risk of adverse health outcomes, including falls, hospitalisations, disability, institutionalisation, and mortality.[4] Due to such harmful effects, frailty is a key indicator of the well-being of older people. In particular, with the ageing population, it has become a key challenge in the effort of increasing healthy life expectancy. Frailty is preventable and modifiable, especially in early stages.[5] Thus, understanding the risk factors of frailty provides opportunities to optimise experiences of ageing and reduce related healthcare burdens.

With regard to risk factors of frailty, most of the evidence concerns physical health factors associated with developing frailty, including older age, female, chronic disease, allostatic load, chronic systemic inflammation, low physical activity, being either underweight or overweight, smoking and heavy drinking.[6] Recent studies suggested that frailty exists in a life-course manner, developing through multiple pathways throughout an individual's lifespan, influenced by multidimensional factors, including mental and social health factors, beyond just physical health.[6] Hence a multidimensional approach to frailty which encompasses the psychosocial dimensions of frailty, beyond physical, elucidates the complexity of care needs required in the prevention and management of frailty.[7].

In mental health, studies found that 16-35% of frail individuals experienced co-existing depression.[8] Although similar biological mechanisms were hypothesised to account for both frailty and depression – for example, subclinical cardiovascular disease and inflammation,[9] it is unlikely that one mechanism is largely responsible for either or both

syndromes. A meta-analysis found a reciprocal interaction between depression and frailty in

older adults, where each condition is associated with an increased incidence of the

development of the other.[10] Anxiety also frequently co-occurs with depression, which, in

combination, is associated with a higher risk of morbidity and mortality.[11]

It is important to note that mental health is more than the absence of psychiatric

disorders. As defined by the World Health Organisation, 'mental health is a state of well-

being in which an individual realises his or her own abilities, can cope with the normal

stresses of life, can work productively and make a contribution to his or her community'.[12] In

line with this definition, mental health determinants of frailty need to include individuals'

psychological well-being (negatively formulated as psychological distress) and self-

management ability, which enables an individual to function within his social context

(negatively formulated as social dysfunction). A review reported eight longitudinal studies

which examined mental health effects on frailty and most examined the role of psychological

distress on frailty through conditions such as depression, anxiety and neuroticism.[13]

However, few studies examined factors relating to lack of self-management ability or social

dysfunction, which was measured by self-perceptions of positive and negative affect,[14] and

personal mastery and self-efficacy.[15]

Social factors are the least well studied in the determinants of frailty. The literature is

still inconclusive on the nature and conceptualisation of social frailty, suggesting various

approaches to it.[16,17] The lack of conceptual and methodological frameworks for social frailty

in older adults makes it difficult to develop a framework for assessment and, as a

consequence, establish the evidence of social effects on frailty.[18] While many studies have

examined the relationships of social health measures with adverse health outcomes such as

cognitive decline and mortality,[19] few studies tested the multiple constructs of social health in

single study design to explore the interrelatedness of the factors. Thus, little is known about

the relative predictive value of each social health factor and the pathways through which

social factors mediate each other's impact.

Social domain is often explored through evaluating the structural and functional

aspects of social relationships,[20] with the interpersonal level assessment involving the

individuals' social networks and one at the community level involving one's integration

within the belonged community.[21] The structural aspects of social networks include the

number of friends/family, the number of encounters with them within a specified period of

time, and other objective measurements. However, different social networks provide various

forms of social support, which is the functional aspect of networks. For example, friend-

based networks tend to be high on emotional support, as friends are generally age-peers, but

low on instrumental support, while the converse can be true for family networks.[22]

Community integration, which includes a structural evaluation of involvement in social

activities, also entails the functional aspect of a sense of belongingness within the

community.[23]

Research suggests that the functional aspects were more relevant to their health and

quality of life compared to the objective measures of structural relations.[18] In relation,

another aspect of social health is loneliness, which can be defined as a subjective state based

on a person's emotional or psychological response to the number and/or quality of social

connections needed in comparison to what is being experienced at the time.[24] It is different

and not necessarily linked to the structural aspect of social isolation as an individual can have

a large number of social connections and still experience the subjective feeling of loneliness,

or alternatively, be objectively isolated but not experience loneliness.[24] Assessment of

loneliness provides insight into the psychological responses to the structural and functional

aspects of social relationships.

In Singapore, the proportion of residents aged 65 and above increased from 8.8% in 2009 to 14.4% in 2019,[25] and the prevalence of frailty ranges from 5.7% to 11.3% in the population,[4] depending on the operationalisation of frailty. Local studies established physical health determinants of frailty such as multimorbidity,[4 26-29] physical exercise,[4] and other lifestyle factors, including smoking,[30] and drinking.[26 28] Mental health determinants included cognitive impairment,[4 28 29] and depressive symptoms.[4 26-28 30 31] Compared to physical and mental domains, the social health domain is the least well studied, with social networks,[28 29] and social activity,[28] both of which evaluate the structural aspects of social health, found to be determinants of frailty. Little research in Singapore investigated physical, social, and mental determinants of frailty concurrently. The study utilised the FRAIL phenotypic scale to assess frailty for comparability with local studies,[4 27 31] and due to its ease of administration.[32] The objective was to assess the effects of psychosocial determinants of frailty on top of physical health in community-dwelling older adults.

Methods

Participants

A door-to-door survey was conducted in October 2019 among 497 older adults living in a public housing town in the central region of Singapore. Older residents with severe cognitive issues rendering them incapable of fully understanding and/or responding to the survey were excluded. This was assessed by the survey interviewers at the time when they introduced the study. The interviewers worked in a team to knock on every unit in the 32 blocks at different times of the day. Verbal informed consent was obtained in the respondent's preferred language, where the anonymity and voluntary nature of the survey was stressed. The survey was administered by the interviewers; responses were entered onto an electronic data collection platform. An umbrella, as a token of appreciation, was provided upon survey completion. Ethics approval was obtained from the university institutional review board.

Measures

In addition to the key measures below, sociodemographic information such as gender, age, ethnicity, religion, education, employment, housing type, and cohabitants, were collected.

Frailty was assessed by the 5-item FRAIL scale, which stands for fatigue, resistance, ambulation, illnesses, and loss of weight.[33] Fatigue was measured by asking respondents how often during the past four weeks they felt tired with responses of "all of the time" or "most of the time" scored as '1'. Resistance was assessed by asking if they had any difficulty walking up ten steps alone without resting and without aids. Ambulation by asking if they had any difficulty walking 300 meters without aids; "yes" responses were each scored as 1 point. Illness was scored 1 for respondents who reported five or more illnesses. Loss of weight was scored 1 for self-report of weight decline of 5% or greater within the past 12 months. Total score ranges from 0 to 5, where a score of 3 to 5 indicates frailty, 1 to 2 as having a pre-frail, and score of 0 as a robust state.

Physical health was assessed through the self-reported presence of chronic diseases such as hypertension, diabetes mellitus, high cholesterol, cardiovascular disease, musculoskeletal disease, thyroid disease, and malignancies. The extent of multimorbidity was calculated by summing the number of chronic diseases of each respondent into ordinal categories ('0' for no, '1' for one to two, '3' for three or more chronic diseases). Functional ability was assessed through (1) ability to perform tasks of daily living without assistance ('0' for no, '1' for yes), and (2) fall history in the past six months ('0' for no, '1' for yes). In addition, we assessed lifestyle factors such as (1) amount of physical activity done in a week ('0' for none, '1' for 0-6 days a week, '2' for every day), (2) smoking history ('0' for no, '1' for yes) and (3) high alcohol intake in the past week ('0' for no, '1' for yes).

Mental health was assessed using the 12-item General Health Questionnaire (GHQ-12), which has been shown to screen reliably and accurately for psychiatric disorders such as

depression in primary care and outpatient settings.[34] It includes questions relating to the psychological state of respondents and whether they have been feeling different recently, allowing to detect any recent changes in the respondents' psychological status and coping ability. The factors of GHQ-12 have been widely reported across regions. The two subscales utilised in this study were named psychological distress, and social dysfunction,[35] and they have high internal consistency (Cronbach's α=.87, .88, respectively).

Social health was assessed by social networks, community integration, and loneliness. Social networks were assessed using the 6-item Lubben's Social Network Scale.[36] It measures the quantity of social networks among family/relatives and friends that the older person 'sees or hears from at least once a month', 'feels at ease to talk about private matters', and 'can call on them for help.' Each item was scored from 0 to 5. Total scores ranged from 0 to 30; higher scores indicated larger social networks. There was good reliability of the family/relatives subscale (α=.87) and friend subscale (α=.85) in the sample. Community integration was assessed using the Community Integration Measure (CIM).[37] It contains measures of the perceptions of community belongingness and participation in community activities,[38]. Items from the CIM survey were initially designed and validated in a study to assess community integration among people with acquired brain injury but has since been validated for the general population as well,[37]. In the study, we adopted nine items on the scale. Each item was scored from 1 to 4, and total scores ranged from 9 to 36, where higher scores indicated higher community integration. There was good reliability for the CIM scale in the sample (α= .79). Loneliness was assessed by the 3-item UCLA Loneliness Scale,[39] which asks the frequency of experiencing 'lack companionship, 'feel left out', and 'isolated from others'. Each item was scored from 1 to 3; total scores ranged from 3 to 9. There was good reliability for the UCLA Loneliness scale in the sample (α= .90).

Data analysis

The presentation of each FRAIL item (fatigue, resistance, ambulance, illness and loss of weight) and resulting frailty categories were described. Categorical variables such as demographic characteristics, multimorbidity status, and lifestyle factors were reported where chi-square tests were conducted to test the differences across frailty levels. One-way analysis of variance (ANOVA) was conducted for continuous variables. Spearman correlations between the variables were conducted. Hierarchical ordinal regression analyses were performed to identify the independent predictors of frailty. Variables that were significant at the bivariate level with $p < .10$ were entered into the multiple regression models. Age and physical health factors were entered in the first step, followed by physical activity (step 2), mental health (step 3) and social health (step 4). The regression model was adjusted for demographic variables that were significantly associated with frailty.

Results

Prevalence of frailty

Table 1 shows the frailty assessment. Of the symptoms reported, "difficulty walking ten steps without aid" was the most common (25%), followed by "difficulty walking 300 meters without aid" (22%), fatigue (20%), significant weight loss in the past year (4%) and diagnosis of five or more illnesses (2%). Adding these up, the prevalence of frailty and prefrailty in the study sample was 8% and 33%, respectively.

[Table 1 Here]

Characteristics of participants

Table 2 shows the demographic characteristics of participants by the level of frailty. The majority of participants were in their age of 60 to 80 years old (86%), of Chinese ethnicity (91%), unemployed (84%), did not live alone (86%), and about half (57%) were female. Sociodemographic characteristics such as age, education, and employment differed by frailty level (χ^2=33.0, 20.2 and 5.9 respectively, all p<.05). In the age group of 81 to 90 years old,

the proportion of robust and prefrail notably decreased; only 9% robust and 18% prefrail

were reported. With regard to education, 14% of the robust group reported no education

compared to 30% of prefrail and 21% of frail. For employment, 81% of the robust group

reported being unemployed compared to 86% of prefrail and 95% of frail. Other

sociodemographic characteristics did not differ by frailty level.

[Table 2 Here]

Physical, mental and social health

Table 3 shows the physical, social and mental health status by the level of frailty. Frailty was

significantly associated with multimorbidity (χ^2=20.1, p<.001). The proportion of older adults

reporting two to three diseases increased from 44% to 46% to 69% with an increasing level

of frailty. While hypertension (43%), high blood cholesterol (30%), and diabetes mellitus

(21%) were prevalent among the older adults, the prevalence rates were not different across

the three-level of frailty. Instead, less prevalent conditions, like cardiovascular (7%) and

musculoskeletal (5%) diseases differed by the level of frailty (χ^2=23.1 and 48.9, respectively,

all p<.001). Poor functional ability was associated with frailty, with the proportion of older

adults reporting ability to perform daily tasks of living without assistance decreasing from

94% to 83% to 67% with an increasing level of frailty, and the proportion of older adults

reporting falls in the last six months increasing from 5% to 15% to 18% across the levels of

frailty (χ^2=32.2 and 15.4, respectively, all p<.001). The level of frailty also differed by

frequency of physical activity (χ^2=13.6, p<.01), where no physical activity in a week

increased from 20% to 24% and 41% with increasing level of frailty. With regard to mental

health, both psychological distress and social dysfunction were significantly associated with

frailty (*F*=6.2 and 22.1, respectively, all p<.001). For social health, frailty was significantly

associated with a lower level of community integration and smaller size of social networks

with friends (*F*=3.4 and 3.8, respectively, all p< .05). The association between loneliness and

frailty was higher than other social factors (F=19.7, p< .001). Social network with family members was not associated with frailty.

[Table 3 Here]

Correlations

Table 4 shows the correlations between the study variables. Multimorbidity was positively correlated with having fallen in the past six months (r=.10), loneliness (r=.09) and social dysfunction (r=.09). Functional ability – being able to perform tasks of living without assistance – was positively correlated with physical activity (r=.11), community integration (r=.10), social networks with friends (r=.15), but negatively correlated with social dysfunction (r=-.17) and loneliness (r=-.10). Physical activity was positively correlated with community integration (r=.13) and social networks with friends (r=.20) but negatively correlated with social dysfunction (r=-.19) and loneliness (r=-.11). Social networks with friends was positively correlated with community integration (r=.43), while negatively correlated with loneliness (r=-.25). Loneliness was negatively correlated with community integration (r=-.20). Loneliness was most strongly correlated with mental health factors, with positive correlations with psychological distress (r=.30) and social dysfunction (r=.25).

[Table 4 Here]

Hierarchical regression

Table 5 presents the results of regression models of frailty, adjusted for education and employment, which were found to be significant at the univariate level. In step 1, increased age (81-90 years old), low (2-3 diseases) and high (> 3 diseases) multimorbidity, and having fallen past six months were associated with increased odds of frailty (adj. OR=2.20, 95% CI: 1.23-3.93, adj. OR=1.70, 95% CI: 1.13-2.75, adj. OR=2.03, 95% CI: 1.18-3.49 and adj. OR=2.04, 95% CI: 1.12-3.73, respectively), whereas the ability to perform daily tasks of living was associated with reduced odds of frailty (adj. OR=0.31, 95% CI: 0.18-0.53). In step

2, physical activity was entered, and increased age, multimorbidity, functional ability and having fallen in the past six months remained significantly associated with frailty. Additionally, three or more days of physical activity per week was found to be associated with decreased odds of frailty (adj. OR=0.61, 95% CI: 0.39-0.97). In step 3, after entering the two mental health variables, physical activity was no longer significantly associated with frailty. Between the two mental health factors, only social dysfunction was associated with increased odds of frailty (adj. OR = 1.28, 95% CI:1.11-1.47), but not psychological distress. In the last step, the effects of social health were tested. Only loneliness but not social networks with friends and community integration was associated with increased odds of frailty (adj. OR = 1.26, 95% CI: 1.06-1.50).

[Table 5 Here]

Discussion

Frailty is a common geriatric state associated with multiple adverse health outcomes in older people. Although physical aspects of frailty are well known, psychosocial factors of frailty are less investigated. The study highlighted the different profiles of physical, social and mental health across robust, pre-frail, and frail older adults with a focus on the effects of psychosocial frailty. The prevalence of 8% frail and 33% pre-frail in the study is comparable to other studies in Singapore: 5.7% and 6.2% frailty and 37.0% and 40.1% pre-frailty in similar age groups.[4][29] Consistent with other studies, frail older adults were more likely to be advanced in age (e.g., 81 years and older), have lower education levels, and be unemployed. Contrary to other international studies,[40] gender was not associated with frailty in our study, and previous local studies also found no association between gender and frailty.[29] This might be explained by gender roles and community engagement.[35]

The finding of the association between multimorbidity and frailty is consistent with previous studies.[4] The proportion of those with one or more chronic diseases increased from

robust to frail older adults. There remained a small proportion of frail older adults without

chronic disease, suggesting frailty from physiologic changes of ageing that are not disease-

based (e.g., ageing-related sarcopenia or anorexia).[3] The study identified musculoskeletal

disease and cardiovascular disease as key clinical conditions most strongly associated with

frailty. Many of the common musculoskeletal problems of old age, including osteoporosis,

osteoarthritis and fragility fractures are associated with mobility problems and can spiral into

functional decline and disability.[41] Cardiovascular diseases are a common end manifestation

of the metabolic syndrome pathway.[42] Not only is there a link between metabolic syndrome

and frailty, but a bilateral association is suggested.[43] Both chronic diseases are preventable at

earlier stages through appropriate interventions.

Regular physical activity contributes to the reversal of detrimental effects of chronic

diseases as well as the maintenance of functional status in older adults, slowing down the

onset of frailty.[44] However, beyond its direct physical benefits, the indirect effects of non-

physical factors should be noted. In the regression model, adding on mental and social health

factors respectively reduced the effects of daily exercise on frailty to non-significant level,

suggesting a mediation effect of psychosocial factors in the relationship. This has

implications for frailty interventions. Frail older adults, who are unable to participate in

physical exercise that is meant for the pre-frail, could still reap the mental and social health

benefits for frailty through the interventions that are less physically taxing.

Social dysfunction was found to be a strong predictor of frailty above increased age,

multimorbidity, functional ability, physical activity and loneliness. The finding can be

explained by the decreased intrinsic ability of older adults to actively self-manage their

ageing process and to cope with and be in control of their health needs, as the assessment of

self-management ability (negatively formulated as social dysfunction) included items on

decision-making, facing up to problems, concentration ability, and feeling that one is playing

a useful role in things. The concept of self-management is applied to not only chronic

diseases but also psychosocial problems such as depression and loneliness.[45] Older adults

experience multiple and interacting challenges across the physical, mental, and social

domains that need to be managed simultaneously to delay the progression of frailty. They

benefit more from broad self-management interventions, which equip them with the intrinsic

skills to address his overall well-being rather than short term extrinsic interventions, which

focus on just one problematic aspect of physical or psychosocial health.[45]

The multifactorial assessment of social frailty yielded important insights. Deficits in

each component of social health – social networks, community integration, and loneliness –

were individually associated with frailty at the bivariate level, while only moderately

correlated with each other, suggesting that these are distinct but interrelated factors. At the

multivariate level, only loneliness was found as an independent predictor of frailty.

Loneliness is regarded as a psychological manifestation outcome of a lack of social networks

or a feeling of dissatisfaction regarding the frequency and closeness of social contacts.[46]

Thus, loneliness may mediate the relationship between the structural components of social

networks and community integration and frailty. For example, the Irish Longitudinal Study

on Ageing found that loneliness was a significant mediator on the association between social

networks and depression.[47] Hence community interventions to promote mental and social

health will be needed to reduce loneliness amongst the older adults who are at risk of frailty.

Limitations

There are several limitations to the study. Its cross-sectional nature limits inference on the

directionality of associations. While the door-to-door survey will reduce selection bias, as

opposed to convenience sampling at community centres, there were yet non-response bias as

older adults with depression were unwilling or unable to participate in the survey. As the

majority of the surveys were administered during working hours, we captured a larger pool of

unemployed or retired participants as compared to working older adults who may have a more robust profile. Due to the self-reporting nature of our interviews, older residents with severe cognitive issues that rendered them incapable of fully understanding and/or responding to the survey were excluded. While respondents with mild to moderate cognitive impairments were still able to participate in the survey, the true impact of cognitive decline on frailty could not be evaluated as the most severe cases were excluded. Given the complex, potentially multiplicative, effects of cognitive functions, depression, social isolation, and loneliness on frailty, further research is needed to examine the intersectionality of these domains and their impact on frailty.[48]

Conclusion

The study demonstrated the importance of the psychosocial dimensions of frailty in older adults. Public health intervention for healthy ageing should address how mental and social health affects an individual's progression to frailty. Programme evaluation and implementation research need to incorporate appropriate frameworks and measures to understand the underlying psychosocial mechanisms and interrelated components of frailty prevention programmes. In policy, health life expectancy based on physical frailty should incorporate psychological frailty for well-being in a lifetime course. Effective translation of scientific knowledge of social frailty in practice is crucial to meet the unmet needs of older adults in the local context.

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Table 1. Prevalence of frailty and categorisation

Measures of frailty	N (%)
FRAIL Scale Items	
Feeling tired	98 (19.7)
Difficulty walking up 10 steps without aids and rest	125 (25.2)
Difficulty walking 300m without aids	107 (21.5)
Diagnosed with 5 or more illnesses/diseases	10 (2.0)
Significant weight loss in the past year (>5% change)	22 (4.4)
Frailty Categories	
Robust (0 conditions)	296 (59.5)
Prefrail (1-2 conditions)	162 (32.6)
Frail (3-5 conditions)	39 (7.9)

Table 2. Demographic characteristics by level of frailty

	Total	Robust	Prefrail	Frail	χ2
	N (%)	N (%)	N (%)	N (%)	
Age					33.0 ***
60 – 70	229 (46.1)	150 (50.7)	69 (42.6)	10 (25.7)	
71 – 80	197 (39.6)	120 (40.5)	64 (39.5)	13 (33.3)	
81 – 90	71 (14.3)	26 (8.8)	29 (17.9)	16 (41.0)	
Gender					3.3
Male	214 (43.1)	137 (46.3)	61 (36.7)	16 (41.0)	
Female	283 (56.9)	169 (53.7)	101 (62.3)	23 (59.0)	
Ethnicity					1.9
Chinese	451 (90.7)	272 (91.9)	144 (88.9)	35 (89.7)	
Malay	17 (3.4)	9 (3.1)	7 (4.3)	1 (2.6)	
Indian	27 (5.5)	14 (4.7)	10 (6.2)	3 (7.7)	
Others	2 (0.4)	1 (0.3)	1 (0.6)	0 (0.0)	
Education					20.2**
None	99 (19.9)	42 (14.2)	49 (30.2)	8 (20.5)	
Primary	171 (34.4)	109 (36.8)	45 (27.8)	17 (43.6)	
Secondary	166 (33.4)	103 (34.8)	53 (32.7)	10 (25.6)	
Pre-Tertiary/Tertiary	61 (12.3)	42 (14.2)	15 (9.3)	4 (10.3)	
Employment					5.9*
Employed	80 (16.1)	56 (18.9)	22 (13.6)	2 (5.1)	
Unemployed	417 (83.9)	240 (81.1)	140 (86.4)	37 (94.9)	
Lived Alone					2.2
No	429 (86.3)	250 (84.5)	144 (88.9)	35 (89.7)	
Yes	68 (13.7)	46 (15.5)	18 (11.1)	4 (10.3)	

* p < .05 ** p < .01 *** p < .001

Table 3. Physical and psychosocial health status by level of frailty

	Total	Robust	Prefrail	Frail	χ2 or F
	N (%)	N (%)	N (%)	N (%)	
Multimorbidity					20.1***
None (0-1 diseases)	190 (38.2)	131 (44.3)	54 (33.3)	5 (12.8)	
Low (2-3 diseases)	231 (46.5)	129 (43.6)	75 (46.3)	27 (69.3)	
High (≥ 4 diseases)	76 (15.3)	36 (12.1)	33 (20.4)	7 (17.9)	
Chronic Diseases					
Hypertension	211 (42.5)	116 (39.2)	78 (48.1)	17 (43.6)	3.5
Diabetes mellitus	102 (20.5)	57 (19.3)	40 (24.7)	5 (12.8)	3.4
High blood cholesterol	148 (29.8)	88 (29.7)	51 (31.5)	9 (23.1)	1.1
Cardiovascular disease	33 (6.6)	10 (3.4)	14 (8.6)	9 (23.1)	23.1***
Musculoskeletal disease	26 (5.2)	2 (0.7)	14 (8.6)	10 (25.6)	48.9***
Thyroid	9 (1.8)	6 (2.0)	2 (1.2)	1 (2.6)	0.5
Other diseases	37 (7.4)	15 (5.1)	15 (9.3)	7 (17.9)	9.4**
Functional ability					
Daily living w/o assistance	440 (88.5)	279 (94.3)	135 (83.3)	26 (66.7)	32.2***
Fallen in the past 6 months	48 (9.7)	16 (5.4)	25 (15.4)	7 (17.9)	15.4***
Physical Activity					13.6**
0 day/week	113 (22.7)	58 (19.6)	39 (24.1)	16 (41.0)	
1-2 days/week	99 (19.9)	63 (21.3)	26 (16.0)	10 (25.6)	
≥ 3 days/week	285 (57.3)	175 (59.1)	97 (59.9)	13 (33.3)	
Smoke	50 (10.1)	37 (12.5)	12 (7.4)	1 (2.6)	5.6
Drink	42 (8.5)	28 (2.5)	12 (7.4)	2 (5.1)	1.2
Mental Health					
Psychological distress	10.06 (3.09)	9.70 (2.82)	10.27 (3.03)	11.85 (4.28)	6.2***
Social dysfunction	12.03 (1.92)	11.67 (1.78)	12.30 (1.54)	13.64 (3.12)	22.1***
Social Health					
Community integration	26.34 (3.78)	26.68 (3.90)	25.96 (3.21)	25.33 (4.74)	3.4*
Social network with family	7.29 (3.44)	7.28 (3.51)	7.21 (3.28)	7.72 (3.63)	0.3
Social network with friends	6.22 (4.38)	6.63 (4.32)	5.77 (4.24)	4.97 (5.06)	3.8*
Loneliness	3.46 (1.17)	3.28 (0.89)	3.54 (1.27)	4.47 (1.89)	19.7***

Note: psychological distress: range 6-24, social dysfunction: range 6-24, community integration: range 9-36, social network with family and friends: range 0-15, and loneliness: range 3-9. * p < .05 ** p < .01 *** p < .001

Table 4. Correlations between study variables

	1	2	3	4	5	6	7	8	9
1. Multimorbidity	-								
2. Daily living w/o assistance	-.07	-							
3. Fallen in the past 6 months	.10*	-.07	-						
4. Physical activity	-.01	.11*	.01	-					
5. Psychological distress	.08	-.03	.05	-.06	-				
6. Social dysfunction	.09*	-.17***	.09	-.19***	.35***	-			
7. Community integration	-.02	.10*	.02	.13**	-.16***	-.26***	-		
8. Social network with friends	.02	.15**	.03	.20***	-.8	-.21***	.43***	-	
9. Loneliness	.09*	-.10*	-.01	-.11*	.30***	.25***	-.20***	-.25***	-
10. Frailty level	.17***	-.24***	.18***	-.09*	.14**	.24***	-.12**	-.12**	.21***

$* p < .05 ** p < .01 *** p < .001$

Table 5. Hierarchical ordinal regression for frailty

	Model 1	Model 2	Model 3	Model 4
	Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. OR (95% CI)
1. Age and physical health				
Age				
60 – 70	-	-	-	-
71 – 80	1.01 (0.67 – 1.52)	1.05 (0.69 – 1.61)	1.05 (0.69 – 1.62)	1.05 (0.68 – 1.61)
81 – 90	2.20 (1.23 – 3.93)**	2.25 (1.26 – 4.04)**	2.30 (1.28 – 4.14)**	2.22 (1.23 – 3.99)**
Multimorbidity				
None (0-1 disease)	-	-	-	-
Low (2-3 diseases)	1.70 (1.13 – 2.57)*	1.71 (1.31 – 2.59)*	1.60 (1.05 – 2.44)*	1.56 (1.02 – 2.38)*
High (≥ 4 diseases)	2.03 (1.18 – 3.49)*	2.06 (1.19 – 3.55)**	1.87 (1.08 – 3.26)*	1.83 (1.05 – 3.18)*
Functional ability				
Daily living w/o assistance	0.31 (0.18 – 0.53)***	0.32 (0.19 – 0.57)***	0.38 (0.21 – 0.66)***	0.41 (0.23 – 0.73)**
Fallen in the past 6 months	2.04 (1.12 – 3.73)*	2.13 (1.16 – 3.91)*	2.12 (1.15 – 3.94)*	2.18 (1.18 – 4.06)*
2. Lifestyle				
Physical Activity				
W0 days/week		-	-	-
1-2 days/week		0.58 (0.33 – 1.03)	0.67 (0.37 – 1.20)	0.67 (0.37 – 1.22)
≥ 3 days/week		0.61 (0.39 – 0.97)*	0.78 (0.48 – 1.25)	0.81 (0.50 – 1.31)
3. Mental Health				
Psychological distress			1.03 (0.96 – 1.11)	1.01 (0.94 – 1.06)
Social Dysfunction			1.28 (1.11 – 1.47)***	1.24 (1.08 – 1.43)**
4. Social Health				
Community integration				1.00 (0.94 – 1.06)
Network with Friends				0.99 (0.95 – 1.04)
Loneliness				1.26 (1.06 – 1.50)**

Note: Multiple regressions also adjusted for education and employment which were not significant predictors in all models. * p < .05 ** p < .01 *** p < .001

2

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	#3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	#4	Present key elements of study design early in the paper	8

Setting	[#5](#5)	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Eligibility criteria	[#6a](#6a)	Give the eligibility criteria, and the sources and methods of selection of participants.	8
	[#7](#7)	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-10
Data sources / measurement	[#8](#8)	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	9-10
Bias	[#9](#9)	Describe any efforts to address potential sources of bias	8
Study size	[#10](#10)	Explain how the study size was arrived at	8
Quantitative variables	[#11](#11)	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	9-10
Statistical methods	[#12a](#12a)	Describe all statistical methods, including those used to control for confounding	11
Statistical methods	[#12b](#12b)	Describe any methods used to examine subgroups and interactions	11
Statistical methods	[#12c](#12c)	Explain how missing data were addressed	na
Statistical methods	[#12d](#12d)	If applicable, describe analytical methods taking account of sampling strategy	11
Statistical methods	[#12e](#12e)	Describe any sensitivity analyses	na

Results

Participants	[#13a](#13a)	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	11

Participants	[#13b](#)	Give reasons for non-participation at each stage	na
Participants	[#13c](#)	Consider use of a flow diagram	na
Descriptive data	[#14a](#)	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	11
Descriptive data	[#14b](#)	Indicate number of participants with missing data for each variable of interest	na
Outcome data	[#15](#)	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	11
Main results	[#16a](#)	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-14
Main results	[#16b](#)	Report category boundaries when continuous variables were categorized	11-14
Main results	[#16c](#)	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	[#17](#)	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	na

Discussion

Key results	[#18](#)	Summarise key results with reference to study objectives	14-16
Limitations	[#19](#)	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	16
Interpretation	[#20](#)	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	15-16
Generalisability	[#21](#)	Discuss the generalisability (external validity) of the study results	na

Other

Information

Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

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